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BULLETIN OF MARINE SCIENCE, 34(2): 267–279, 1984 CORAL REEF PAPER

SOUTH ATLANTIC BIGHT REEF FISH COMMUNITIES AS REPRESENTED IN HOOK-AND-LINE CATCHES

Alexander J. Chester, Gene R. Huntsman, Patricia A. Tester and Charles S. Manooch, III

ABSTRACT

Analyses of catch records from 9,027 headboat trips and 124 research cruises taken over the continental shelf of North Carolina and South Carolina revealed groups of distributionally similar reef fish species. A complex, inner-shelf community, dominated by sea bass (*Centropristis* spp.) and porgies (*Calamus* spp. and *Stenotomus* spp.), was present in waters <30 m throughout the study area. A well-defined community of deep-living (> 100 m) *Epinephelus* groupers (*E. niveatus, E. nigritus, E. flavolimbatus*) was observed at the continental shelf edge. The mid-shelf region (30–100 m) was populated by a diverse group of wide-ranging species whose distributions often extended into shallower or deeper waters. The North Carolina mid-shelf community included red porgy (*Pagrus pagrus*), vermilion snapper (*Rhomboplites aurorubens*) and gray triggerfish (*Balistes capriscus*). Off South Carolina, this community was joined by two others, a red hind–rock hind–scamp (*E. adscensionis–E. guttatus–Mycteroperca phenax*) community and a speckled hind–knobbed porgy (*E. drummondhayi–Calamus nodosus*) community. The identified communities are discussed with respect to temperature, depth and latitudinal distribution, including comments on occurrence south to Florida and into the Gulf of Mexico.

Although reef fish communities of the outer continental shelf of the South Atlantic Bight have supported important recreational headboat fisheries for over two decades (Huntsman, 1976) and commercial handline and trawl fisheries for about 5 years (Ulrich et al., 1976), descriptions of these communities have been qualitative and superficial (Huntsman, 1976; Grimes et al., 1982). In this paper we analyze data from the headboat fishery and from a series of research cruises to present a quantitative description of fish community relationships and of individual species distributions as they are expressed in hook-and-line catches from the outer continental shelf of North Carolina and South Carolina. Although our major purpose is to provide a zoogeographic description, the analysis may also be useful in fishery management. For instance, Ralston (1981) achieved a considerable increase in precision of estimates of potential yield from a Hawaiian reef fishery by computing sub-estimates for each of several component communities.

Our focus here is on the communities occurring on hard, or "live" bottom in water deeper than 20 m, where most species are tropical or subtropical. We do not discuss the nearshore shallow communities dominated by sciaenids and other estuarine-dependent fishes, nor do we discuss communities occupying the vast plains of unconsolidated sediments on the Carolina shelf. These latter assemblages, typified by sea robins (Triglidae) and lizardfishes (Synodontidae), rarely display concentrations of fish large enough to attract recreational or commercial fishermen (Wenner, in press).

Until the 1970's there had been little research and few reports on the live-bottom fishes of the South Atlantic Bight. Smith (1905) and Radcliffe (1914) recognized the existence of tropical species on live-bottom areas in their reports on the fauna of North Carolina and on explorations for black sea bass (*Centropristis striata*) fishing grounds. Buller (1951) also documented the occurrence of numerous reef species. The first extensive surveys of the bight were conducted aboard the vessels OREGON, COMBAT, and SILVER BAY in the late 1950's and early 1960's (Bullis and Thompson, 1965). Designed to find commercial concentrations of fishery resources, these cruises added significantly to our knowledge of the bight's fauna and led to Struhsaker's (1969) description of benthic habitats, which for the first time clearly identified the tropical nature of the outer continental shelf. In 1972, the National Marine Fisheries Service initiated a study of the South Atlantic headboat fishery and of the life histories and population dynamics of important species. Shortly thereafter, the South Carolina Department of Wildlife and Marine Resources began monitoring the commercial reef fisheries.

Although numerous studies describing the fauna of South Atlantic Bight reefs (Huntsman and Dixon, 1975; Grimes et al., 1977; Grimes et al., 1982; Miller and Richards, 1980) and the life histories of selected fishes (Manooch and Huntsman, 1977; Grimes, 1978; Ross, 1982) have been published in recent years, only three considered the subject of reef fish communities, and these define communities with respect to location and depth rather than by faunal assemblage. Struhsaker (1969) referred to live-bottom, shelf edge, and lower shelf habitats in his description of trawl catches. Miller and Richards (1980), using data from trawl surveys, considered inshore (<18 m), intermediate (18–55 m), and offshore (55–183 m) reefs and believed the fauna of each type resulted from the interaction of thermal regimes with three temperature-associated species groupings. Lists of indicator species for each reef type generally did not contain the species that fishermen would encounter. Grimes et al. (1982), using data from hook-and-line survey cruises, provided a species list for only two communities, one on inshore live-bottom, the other at the shelf edge. Here we use the extensive headboat catch records collected by NMFS as well as a smaller set of data from exploratory cruises to identify and determine the distributions of major species groupings.

METHODS

Sources of Data.—Records from 9,027 headboat trips taken over the continental shelf of North Carolina and South Carolina from 1975 through 1978 were included in the analysis of fish communities and in the preparation of species distribution maps. Most trips occurred during May through October, but some were made as early as March and as late as December. The captain or mate of each vessel prepared a daily report of the number of fish taken by species, the number of anglers aboard, the duration of the trip, and the location of fishing (Huntsman et al., 1978). Few operators kept records for every trip, and fishing location was sometimes omitted from otherwise complete records. Overall we had complete records for 50%–60% of all trips.

Fishing locations were reported as positions (by alphanumeric code) on a 10′ longtitude by 10′ latitude, polar-oriented grid (Fig. 1). A finer scale and different orientation would have been preferable for two reasons. First, large quadrat areas often included greatly different water depths and, consequently, greatly differing fish communities, especially along the steep continental shelf slope. Second, the N–S, E–W orientation did not reflect the NE–SW alignment of isobaths and habitats parallel to the shelf edge. Many vessel operators objected to providing specific locations because they did not want to reveal fishing spots, and most would have rejected a more complex recording system. Therefore, the grid was chosen as a compromise between our desire for detailed zoogeographic information and the need for operator acceptance.

In addition to headboat records, we analyzed catch data from 124 exploratory hook-and-line cruises made by the R/V ONSLOW BAY and vessels chartered by NMFS. Cruises occurred during 1972 through 1977 and yielded data covering all months. These data were used to classify trips according to species composition of the catch, and, when combined with knowledge of precise fishing location, contributed a detailed view of community distribution.

Data Analysis.—Catch data from headboat cruises were subjected to a principal component analysis (PCA) (Cooley and Lohnes, 1971). Basically, PCA transforms a set of intercorrelated variables to a lesser number of mutually uncorrelated components, each of which accounts for a diminishing proportion of the total variance in the original data. Correlation coefficients are constructed for all variable-component combinations, and each variable (species) may then be assigned to the component (com-

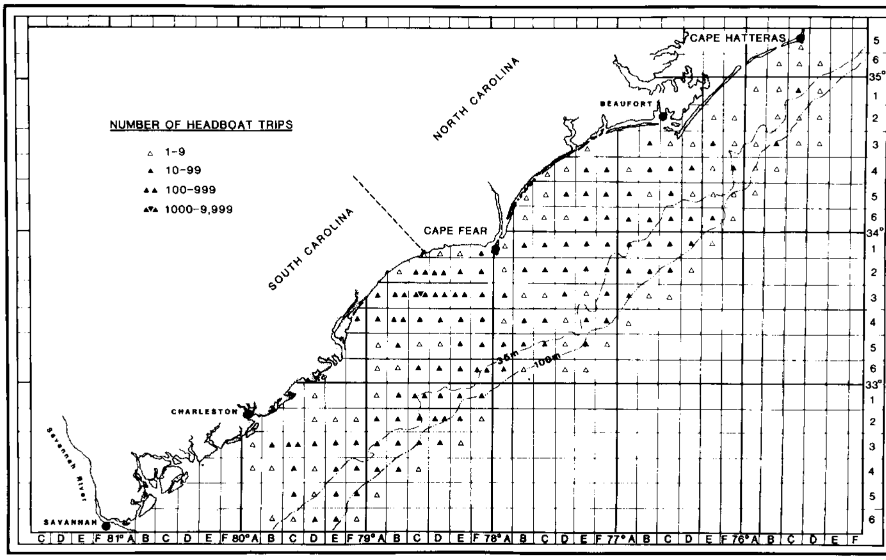


Figure 1. Geographic distribution of headboat trips for which catch records are available, 1975–1978.

munity) it most correlates with. To reduce the risk of spurious correlations induced by rare species (Field et al., 1982), only those species encountered on > 1% of the trips were included in the analysis. The data were arranged in a trip-by-species matrix, species counts were log (x + 1) transformed, and a species-by-species correlation matrix was produced for analysis by PCA.

Data from NMFS research cruises were also analyzed by PCA, but the trip-by-species matrix was transposed so that fishing locations could be grouped by catch characteristics. The total number of fishing trips was first reduced to 100 because of computer storage limits. This reduction was made based on field notes indicating abnormal fishing conditions (e.g., extraordinary current or weather conditions) or lack of fishing success. Following a log (x + 1) transformation, a trip-by-trip correlation matrix was produced and analyzed by PCA. Fishing locations (trips) were assigned to the highest correlated component.

Based on PCA of the headboat catch data, key species were chosen and mapped according to the number of fish taken by grid cell during the 4-year period. Total catch was used as an index of distribution. Although catch per unit of effort (CPUE) is the usual choice for this purpose, it was not suitable here because headboats only fish at sites within grid sectors where there are concentrations of fish, and CPUE is acceptably high. Consequently, CPUE would not distinguish between sectors containing many good fishing sites and sectors containing few. Use of total catch as an index of abundance required the assumption that vessels were available to fish in a sector if fish were present. The even distribution of headboats and their high speed allowed access to every grid sector within the 100 m isobath (Fig. 1). Also, there was intense competition for fishing sites. Thus, we assumed that high catch indicated great abundance and low catch indicated scarcity. The mapped values are actually indices of total catch, since incomplete reporting reduced the values and overestimation of catches (Huntsman et al., 1978) inflated them.

Results

Species Groupings From Headboat Records.—Of 64 species encountered in the 4-year headboat series, only 24 (each occurring in >1% of trips) were retained in the analysis. PCA yielded six components which together accounted for 56.3% of the total variance (Table 1). Most species were strongly associated with one component and were assigned to a single community. However, several species correlated moderately with two or more components and were interpreted as having multiple community affinities.

Table 1. Principal component analysis of catch records from the headboat fishery, 1975–1978. Species in parentheses indicate secondary associations. Correlation coefficients are given for species-component pairs

Component Number	Scientific Name	Common Name	Correlation Coefficient
I	*Pagrus pagrus*	Red Porgy	0.70
	Rhomboplites aurorubens	Vermilion Snapper	0.64
	Lutjanus campechanus	Red Snapper	0.74
	Mycteroperca microlepis	Gag	0.57
	Haemulon plumieri	White Grunt	0.45
	Balistes capriscus	Gray Triggerfish	0.66
	(*Mycteroperca phenax*)	(Scamp)	0.48
II	*Epinephelus niveatus*	Snowy Grouper	0.87
	Epinephelus nigritus	Warsaw Grouper	0.46
	Epinephelus flavolimbatus	Yellowedge Grouper	0.79
	Caulolatilus microps	Blueline Tilefish	0.81
III	*Epinephelus morio*	Red Grouper	0.65
	Epinephelus adscensionis	Rock Hind	0.77
	Epinephelus guttatus	Red Hind	0.77
	Mycteroperca phenax	Scamp	0.54
	(*Haemulon plumieri*)	(White Grunt)	0.44
IV	*Calamus nodosus*	Knobbed Porgy	0.71
	Epinephelus drummondhayi	Speckled Hind	0.72
	Centropristis striata	Black Sea Bass	−0.62
	Seriola spp.	Amberjacks	0.48
	(*Balistes capriscus*)	(Gray Triggerfish)	0.42
	(*Pagrus pagrus*)	(Red Porgy)	0.45
V	*Calamus penna*	Sheepshead Porgy	0.74
	Stenotomus caprinus	Longspine Porgy	0.77
	Haemulon aurolineatum	Tomtate	0.62
	Orthopristis chrysoptera	Pigfish	0.60
VI	*Calamus leucosteus*	Whitebone Porgy	0.62
	Diplodus holbrooki	Spottail Porgy	0.70
	(*Haemulon plumieri*)	(White Grunt)	0.44
	(*Haemulon aurolineatum*)	(Tomtate)	0.43

We tentatively identified seven species groups. These could be related to specific regions on the continental shelf by referring to catch patterns of representative species in the headboat fishery (Huntsman, 1976; Huntsman and Dixon, 1975; Grimes et al., 1977):

COMMUNITY I. These species (red porgy, vermilion snapper, red snapper, gray triggerfish) are distributed along the entire Carolina continental shelf, primarily in mid-depth (40–70 m) reef environments (e.g., Fig. 2a, red porgy).

COMMUNITY II. These species (snowy grouper, warsaw grouper, yellowedge grouper, blueline tilefish) form a group highly characteristic of the deep shelf-break faunal community extending along the entire study area (Fig. 2b, blueline tilefish). Most are restricted to depths >100 m, although juveniles have been reported occasionally from 35 m or less (Huntsman, 1976).

COMMUNITY III. This assemblage (red grouper, rock hind, red hind, scamp) occurs in mid-depth waters (40–70 m), but unlike Community I, it is restricted to the area around Cape Fear, N.C., and south along the South Carolina coast (Fig. 2c, rock hind).

COMMUNITY IV. These species (knobbed porgy, speckled hind) are also most

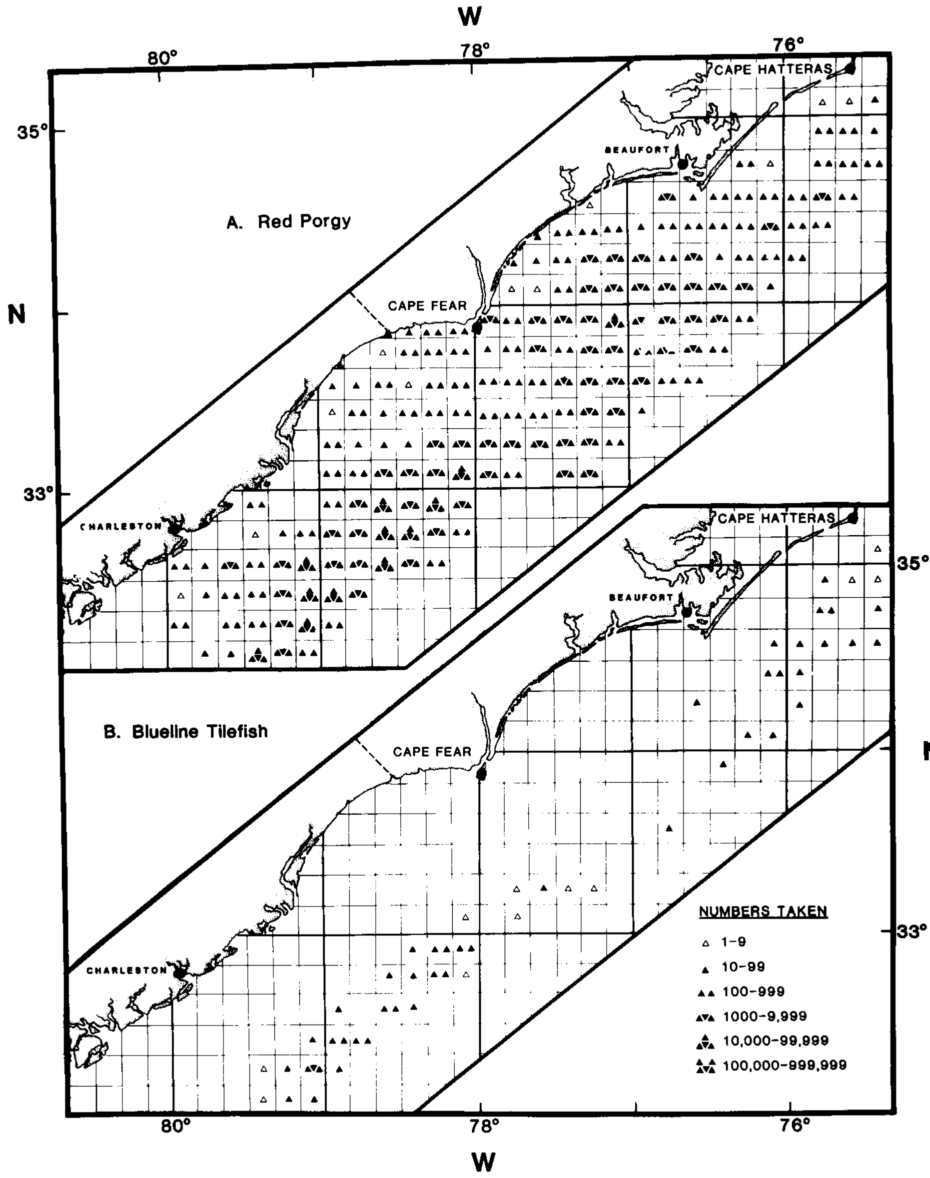
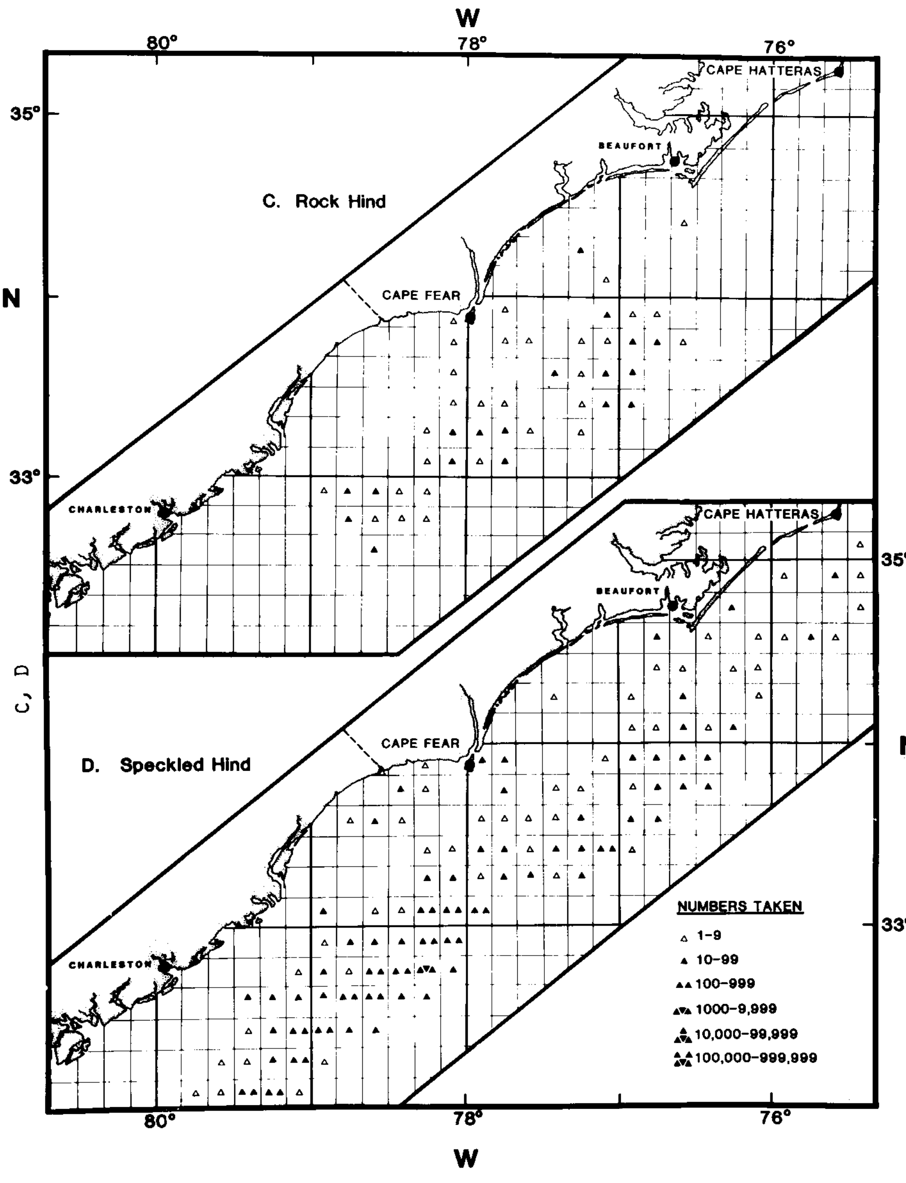


Figure 2a–2f. Distribution of catch (numbers) by species on the North Carolina and South Carolina continental shelf, 1975–1978.

abundant south of Cape Fear but tend to occur in slightly deeper waters (50–100 m) than Communities I and III (Fig. 2d, speckled hind). A negative coefficient for black sea bass indicates a mutually exclusive relationship with other species, and black sea bass, therefore, is considered separately as Community VII.

COMMUNITY V. This association (sheepshead porgy, longspine porgy, tomtate, pigfish) commonly occurs in shallow waters (<30 m) along the entire North Carolina and South Carolina coast (Fig. 2e, tomtate).



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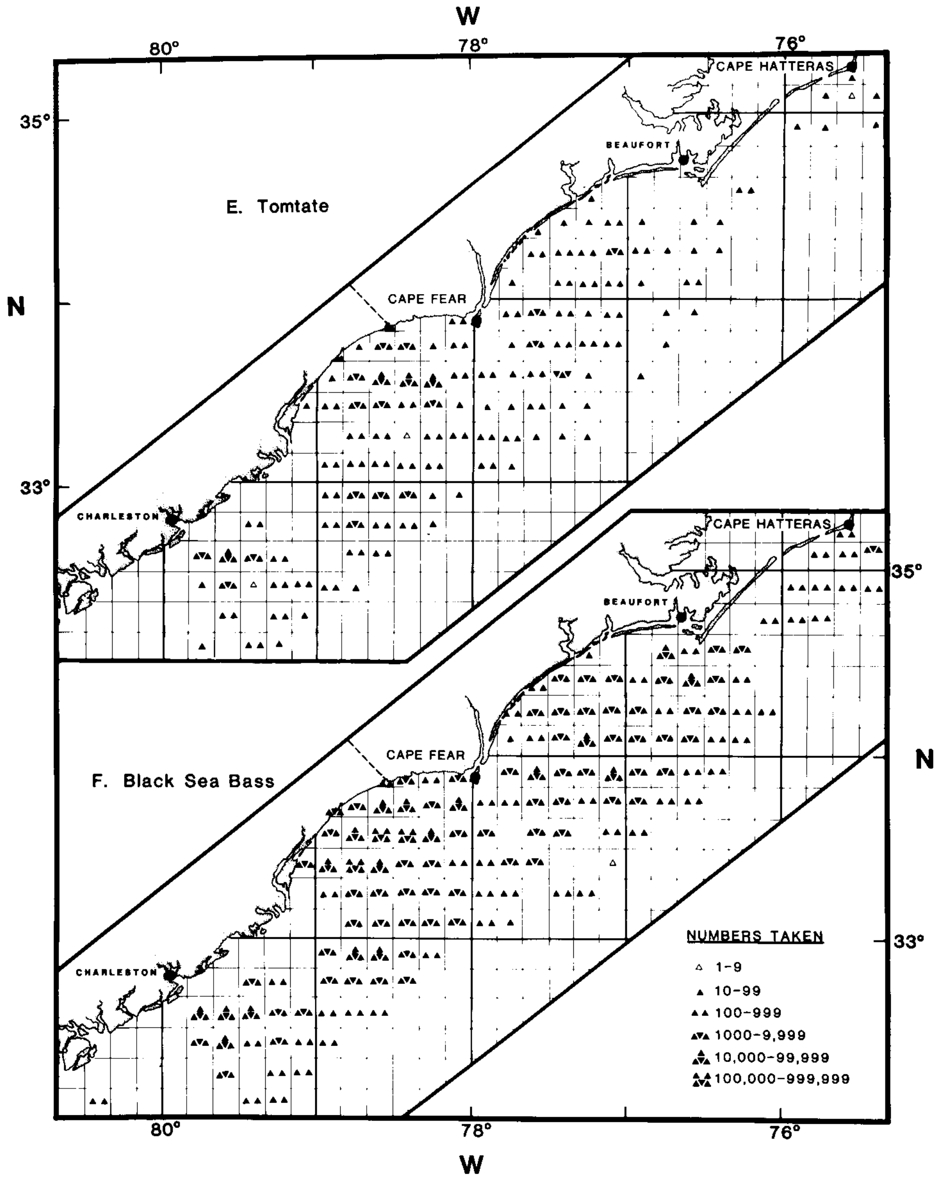
COMMUNITY VI. This group (whitebone porgy, spottail porgy) also occurs in inshore waters (<30 m) throughout the area.

COMMUNITY VII. The only member of this group is black sea bass (Fig. 2f). Hook-and-line catches are often composed exclusively of this one species, so the analysis identifies a unique community.

Communities V, VI, and VII all occupy the inner shelf (<30 m) just seaward of temperate coastal waters and cannot be easily separated by depth or latitude. These three groups may actually constitute a single community. Black sea bass, the only species in Community VII, usually constitute most of the catch in areas



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where Communities V and VI are taken. Further, defining Communities V and VI by the presence of sheepshead porgy or whitebone porgy may not be valid because these species are commonly confused by fishermen and are even difficult for trained observers to tell apart. We therefore suggest that from Cape Hatteras, N.C., to Charleston, S.C., a single inshore community exists dominated by black sea bass but equally well characterized by the presence of a small, regularly occurring fraction of sheepshead, whitebone, spottail and longspine porgies, and tomtate.

Community Distribution from NMFS Survey Cruises.—Three geographically dis-

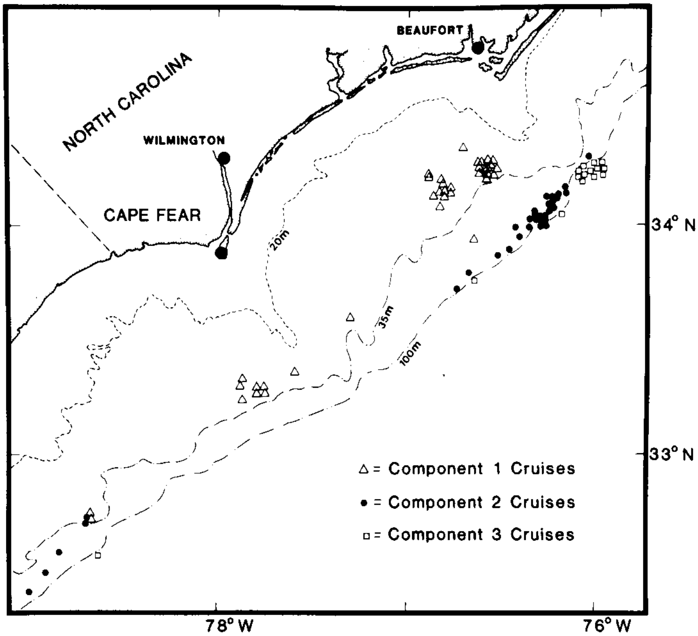

Figure 3. Distribution of NMFS cruises by type (Components I, II, III) from principal component analysis of research catches.

tinct cruise-types (components) were identified on the basis of catch composition. Together these accounted for 79.7% of total variance. Each fishing trip was assigned to the most strongly correlated component ($r \geq 0.70$). A total of 41 trips were associated with Component I, 33 with Component II, and 16 with Component III. A few trips (10) that correlated moderately with more than one component could not be unambiguously classified, and these were deleted from further analysis.

The geographical distribution of each group of trips (Fig. 3) allowed us to examine the influence of depth on community structure and distribution. Component I trips occurred over the inner continental shelf in waters of about 20–35 m; Component II trips occurred on the outer shelf at depths of 60–100 m; Component III trips occurred at the shelf break where depths exceeded 100 m. The species compositions of the reef fish communities of these three regions (Table 2) were significantly different (Multivariate ANOVA, $P < 0.001$). Nearshore cruises (Component I) were defined principally by catches of red porgy, white grunt, black sea bass, bank sea bass, vermilion snapper, gray triggerfish and sand perch. Trips to the outer shelf (Component II) were characterized by red porgy, vermilion snapper, gray triggerfish, almaco jack, greater amberjack, speckled hind and blueline tilefish. Over the shelf break (Component III) catches of red porgy, vermilion snapper, the jacks, blueline tilefish and snowy grouper were common. Since the majority (80%) of cruises occurred in the northern portion of the study area, results are biased toward North Carolina communities.

The catches of the three cruise-types reflected a changing faunal composition related to depth on the continental shelf. Shifts in species composition of the catch were generally consistent with communities identified from headboat rec-

Table 2. Number of each species, averaged over N fishing trips, for three groups of stations identified from principal component analysis of NMFS survey cruises, 1972–1977. Values in parentheses are number of trips on which a given species was caught

Scientific Name	Common Name	Component I (N = 41 trips)	Component II (N = 33 trips)	Component III (N = 16 trips)
Pagrus pagrus	Red Porgy	28.39 (40)	44.79 (33)	16.56 (16)
Calamus leucosteus	Whitebone Porgy	0.59 (12)	0.03 (1)	—
Calamus nodosus	Knobbed Porgy	0.10 (4)	0.18 (6)	—
Diplodus holbrooki	Spottail Porgy	0.10 (2)	—	—
Stenotomus caprinus	Longspine Porgy	0.05 (2)	—	—
Muraenidae	Morays	0.78 (15)	0.15 (4)	0.13 (2)
Trachinocephalus myops	Snakefish	0.15 (5)	0.09 (3)	—
Centropristis ocyurus	Bank Sea Bass	5.44 (35)	0.27 (4)	0.06 (1)
Centropristis striata	Black Sea Bass	50.49 (41)	0.06 (2)	0.06 (1)
Diplectrum formosum	Sand Perch	2.68 (28)	0.06 (2)	—
Epinephelus drummondhayi	Speckled Hind	0.02 (1)	2.64 (28)	—
Epinephelus flavolimbatus	Yellowedge Grouper	—	0.03 (1)	0.75 (6)
Epinephelus morio	Red Grouper	0.07 (2)	0.03 (1)	—
Epinephelus nigritus	Warsaw Grouper	—	0.06 (2)	0.25 (3)
Epinephelus niveatus	Snowy Grouper	—	0.42 (9)	13.81 (16)
Mycteroperca microlepis	Gag	0.51 (10)	0.24 (6)	—
Mycteroperca phenax	Scamp	0.41 (7)	0.09 (3)	—
Serranus phoebe	Tattler	—	0.42 (9)	0.13 (2)
Caulolatilus microps	Blueline Tilefish	—	3.06 (26)	11.00 (16)
Malacanthus plumieri	Sand Tilefish	—	0.18 (3)	—
Syacium papillosum	Dusky Flounder	0.39 (9)	—	—
Seriola dumerili	Greater Amberjack	0.15 (4)	0.85 (12)	0.56 (6)
Seriola rivoliana	Almaco Jack	0.02 (1)	0.76 (11)	0.75 (7)
Lutjanus campechanus	Red Snapper	0.02 (1)	0.33 (6)	0.69 (3)
Lutjanus vivanus	Silk Snapper	—	0.58 (10)	0.38 (3)
Rhomboplites aurorubens	Vermilion Snapper	5.22 (26)	5.97 (29)	8.19 (14)
Haemulon aurolineatum	Tomtate	0.46 (9)	0.21 (2)	—
Haemulon plumieri	White Grunt	11.34 (35)	0.36 (4)	—
Balistes capriscus	Gray Triggerfish	2.88 (30)	2.61 (14)	—

ords. Species from Communities V, VI and VII were largely restricted to the catch of nearshore NMFS cruises. Species from Community II were primarily caught during deep shelf-break cruises. Community I species (especially red porgy and vermilion snapper) were caught by all three NMFS cruise-types, but were generally most abundant at intermediate depths. These species tend to be the most widely distributed with respect to depth and latitude and may form a transitional group overlapping distinct communities in the inshore and shelf-break regions.

Discussion

Temperature is a major factor affecting reef fish distributions in the South Atlantic Bight (Huntsman and Manooch, 1978; Miller and Richards, 1980). Along the North Carolina and South Carolina coasts, a dominant thermal gradient extends from the temperately influenced nearshore zone to the more seasonally-stable, warm waters of the Gulf Stream. A secondary N–S temperature effect intensifies the inshore–offshore gradient to the north and weakens it to the south. Other factors, such as depth and substrate, may interact with temperature. For example, water depth imposes limits on species distributions that may be modified by the thermal regime. Thus, seasonal cooling of Carolina nearshore waters inhibits development of the shallow tropical community found at lower latitudes (Huntsman and Manooch, 1978).

Reef fish communities identified from Carolina headboat records reflect both inshore–offshore and north–south environmental gradients. Distinct changes occur from inshore (Communities V, VI, and VII) to mid-shelf (Community I), to deep shelf-break regions (Community II) along the North Carolina coast. The progression is more complex off South Carolina, with Communities III and IV joining Community I in the mid-shelf region. Slight differences in depth, temperature and substrate may separate the species of these mid-depth groups. For example, the speckled hind assemblage (Community IV) appears to reach maximum development at slightly greater depths than the red grouper-rock hind assemblage (Community III).

Our descriptions of reef fish communities from the northern part of the South Atlantic Bight correspond closely but not perfectly with those of Grimes et al. (1982) and Miller and Richards (1980). Using the same data from NMFS cruises as we did, Grimes et al. (1982) compiled species lists for two faunal assemblages off North Carolina, one on the open shelf (27–64 m) and one at the shelf edge (64–183 m). In contrast, we found distinct inshore and offshore communities separated by a mid-shelf transition group. Miller and Richards (1980) described three reef habitats of the South Atlantic Bight: inshore (<18 m), intermediate (18–55 m) and offshore (55–183 m). However, because they used trawl-based samples it is difficult to compare their indicator species with ours.

The method used for sampling reef fish communities is a major determinant of the species collected. Every technique has serious disadvantages and peculiar biases (Barans, 1982; Gutherz, 1982). Hook-and-line gear is superior for obtaining samples of the large species and can be used on the roughest bottoms. Traps are nearly equivalent in effectiveness but can produce very biased estimates of size frequencies (Hartsuijker, 1982). Trawling, though taking many species unavailable to hook-and-line, is a poor way to sample reef fish (Wenner, in press). The roughest, and usually most productive, bottom must be avoided, and the fish that dominate experimental trawl catches are not those providing most reef biomass. The least biased methods for sampling reef fish are visual, but these are expensive and slow to apply.

The variance accounted for by six components of the Carolina headboat data (56.3%) was similar in magnitude to that explained by other association studies of similar faunal complexity (Gauch, 1982). A high proportion of unexplained variance in the headboat data must be expected because of sampling variability and non-uniform environmental effects on individual species. Problems in sampling variability are ones of non-random selection, uneven observer quality and non-stationary sample locations. Not all fish in a given environment have an equal probability of capture. Factors of gear selectivity such as bait preference and hook size introduce strong biases. Thus many abundant species are not captured at all by headboat fishermen, or are captured so infrequently as to be deleted from the analysis. Reliance on many observers, each having potentially different fish identification skills and attention to duties, is another source of error (Huntsman et al., 1978). Finally, communities were not sampled at statistically controlled or selected sites. Headboats often vary locations within a single cruise and may sample more than one distinct community. Sources of environmental variability are those common to most survey studies. Individual species respond in unique ways to changing environmental conditions. Population responses to biotic factors (e.g., salinity, temperature, depth, current speed) are non-linear functions (Green and Vascotto, 1978) that vary between and within years.

It is more realistic to view the communities defined here not as inflexible entities, but as guides to the general distributional patterns of recreationally-fished reef species. Whittaker (1978) points out that communities are "primarily arbitrary groupings of species by similarity of distributional relationships; the limit of such a grouping and the number of species it is to comprise must be decided by the ecologist." In addition, communities of the type described here are not rigidly bounded; they intergrade along longitudinal, latitudinal and thermal gradients. Thus certain species are more restricted distributionally and are more indicative of specific communities. Snowy grouper and white grunt are limited to specific depth ranges; red hind is confined to the southern portion of the study areas; gag is most abundant in the northern portion. Species like red porgy, vermilion snapper and gray triggerfish are widely distributed and are less diagnostic of specific environments.

The deep reef assemblage is the least studied and documented of the identified communities. The few accounts which treat it are brief or are simply summaries of exploratory fishing ventures (Nelson and Carpenter, 1968; Kawaguchi, 1974; Struhsaker, 1969; Miller and Richards, 1980). Although this community is distributed almost continuously along the continental margin from French Guiana (Kawaguchi, 1974) to North Carolina, and around Caribbean insular shelves, major shifts in the dominance of *Epinephelus* species occur. Along the U.S. South Atlantic shelf, snowy groupers predominate, yellowedge and warsaw groupers are less abundant and misty groupers (*E. mystacinus*) are very rare (Huntsman, 1976; Grimes et al., 1982). In the Gulf of Mexico and off Central and South America, yellowedge groupers predominate, and snowy and warsaw groupers are infrequent (Nelson and Carpenter, 1968). On Caribbean shelves, from Puerto Rico to the east and south, and around Jamaica, misty groupers are abundant, and snowy and warsaw groupers are unreported (Brownell and Rainey, 1971; Kawaguchi, 1974; Thompson and Munro, 1978; Colin, 1974). Snowy, misty and yellowedge groupers are reported from Cuba (Smith, 1971), but no abundance data are available. Böhlke and Chaplin (1968) report only snowy and warsaw groupers from the Bahamas, but extensive exploratory fishing by Thompson (1978) failed to confirm this finding. Instead, misty grouper was common and yellowedge grouper infrequent on the deep reef. Smith (1958) lists misty grouper as common and warsaw grouper as rare from waters off Bermuda.

The shallower and more variable mid-shelf environment has given rise to a more diverse array of communities than found in the deep shelf-break region. The Carolina mid-shelf communities identified here extend from Cape Hatteras, N.C., to Savannah, Ga. Observations of headboat catches and interviews with fishermen suggest that from Jacksonville (30°22′N) to Fort Pierce (27°28′N), Fla., Carolina communities persist in part, but major changes occur. The red porgy is increasingly restricted to the outer shelf, red snapper and red grouper are much more frequent and white grunt is entirely absent. The northernmost regular catches of tropical, shallow reef fishes, especially gray snapper (*Lutjanus griseus*) and mutton snapper (*L. analis*), occur at Jacksonville, and frequency of these species increases to the south. South of Jupiter Inlet (26°58′N) tropical coral reef fish communities occupy the near and mid-shelf (Gilbert, 1972). Red porgy persist in deeper water (>100 m) to the latitude of northern Key Largo (25°20′N). The white grunt, common off the Carolinas, but absent from northeast Florida, again is abundant off southeast Florida.

Close counterparts to Carolina communities exist off the mid and northwest coast of Florida in the Gulf of Mexico. The Gulf population of black sea bass is distributed principally from St. Petersburg north and west along the Florida Panhandle and co-occurs with *Diplodus, Stenotomus,* tomtate and other designated members (or their Gulf counterparts) of our Communities V and VI (B. Rohr, personal communication). The red grouper–red hind assemblage appears to occur on the Florida Middle Grounds as does the scamp–red porgy–vermilion snapper group (Smith et al., 1975; Smith, 1976; B. Rohr, personal communication). Effects of the Mississippi River apparently prevent occupancy of the north-central Gulf by reef fishes, but in the northwestern Gulf a rich reef fauna occurs on hard banks such as the Flower Gardens (Bright et al., 1973; Bright and Rezak, 1976). While the Flower Garden communities appear to be true coral communities, observation of headboat catches suggest there are shallower banks supporting Carolina-type communities (G. B. Sekavec, personal communication).

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ADDRESS: *National Marine Fisheries Service, NOAA, Southeast Fisheries Center, Beaufort Laboratory, Beaufort, North Carolina 28516-9722.*